

TITLE: REMOTE DETECTION OF HAB TOXINS

MILESTONE SHC 1.2.5: Establish methods/protocols for routine ecological forecasts and develop scientific foundations for a broad spectrum of forecasts to reduce negative impacts of natural and human-induced events on ecosystems.

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EXTERNAL COLLABORATORS: Monterey Bay Aquarium Research Institute, University of California at Santa Cruz, Woods Hole Oceanographic Institution

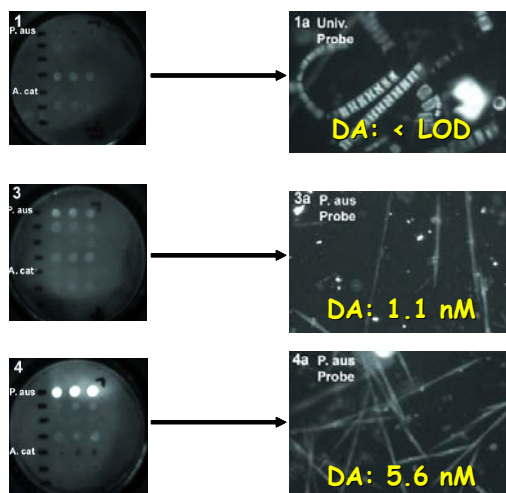
OBJECTIVES OF RESEARCH ACTIVITIES: Investigate the spatial and temporal distributions of HAB toxins associated with bloom events to support biophysical modeling of HABs, and initiate development of autonomous, *in-situ* toxin detection technologies to provide predictive and monitoring capabilities to public health officials and coastal resource managers.

DESCRIPTION OF RESEARCH ACTIVITIES: Harmful algal blooms (HABs) and the toxins frequently associated with these events pose an ever increasing threat to both public and ecosystem health. Knowledge of how toxin distributions vary during a bloom event, incorporation of these data into biophysical models of HABs and, ultimately, advanced warning of impending toxicity by autonomous, *in-situ* detection of algal toxins could markedly enhance the ability of public health officials and coastal resource managers to mitigate the negative impacts of HABs.

Methods required to rapidly detect the toxic source organisms and assess their toxicity have been developed previously. These approaches involve the use of taxon-specific rRNA probes to detect HAB species and receptor binding assays to determine toxin levels associated with the algal cells. Both high throughput methods have been tested extensively on both cultures and field populations of HAB species and have proven to be reliable, robust approaches that can be conducted in the laboratory or onboard ship. Nonetheless, in order to more effectively address the need for *in-situ* detection capabilities, our aim has been to format these methods for use on an automated Environmental Sample Processor (ESP) unit developed by our colleagues at MBARI.

The ESP unit can be deployed on a stationary mooring, autonomously conduct an assay, and transmit the results to a land-based site for processing. The flexibility of this system to accommodate different probes and assay formats make it amenable for use with a wide range of algal taxa as well as toxins, thereby enhancing its utility for monitoring programs.

Images of probe arrays (three left panels; bright spots indicate positive signal) and whole cell hybridizations (right three panels) for *Pseudo-nitzschia australis* from ESP deployment. Annotations in yellow text indicate the domoic acid level for that sample. Note increase in DA corresponds to rise in *P-n. australis* abundance.



Graphic/Image/Figures

Selected Highlights

The following are several important findings from work conducted in 2002:

- During a recent field deployment of the ESP in the Gulf of Maine, the instrument successfully detected and reported the appearance of *Alexandrium* cells at an initial concentration of about 100 cells per liter.
- We are currently developing an antibody-based (i.e., immunological) method for domoic acid detection configured to be performed entirely onboard the ESP platform. New approaches to toxin extraction are also being designed in order to accommodate the limitations in sample manipulation.



Photograph of ESP in MBARI laboratory undergoing testing and final programming (left) prior to field deployment in Monterey Bay, CA (above). For deployment, the instrument is placed inside pressure housing and coupled to a CTD package for measurement of associated water properties.

Publications

Publications/Reports:

Presentations:

Doucette, G.J. Automated, *in-situ* detection of harmful algal species and their toxins using the environmental sample processor. International Society of Exposure Analysis, 2001. Charleston, SC.

Doucette, G.J. Assays for algal toxins: some considerations for remote detection. Workshop on Cyanotoxin Detection, Quantitation, and Instrumentation, 2001, St. Petersburg, FL.

Doucette, G.J. Detection of HAB species, toxins, & toxicities: current approaches & potential for *in-situ* applications. Workshop on Biosensors for Harmful Algal Blooms, 2002. Solomons, MD.

Scholin, C.A., R. Marin III, E. Massion, S. Jensen, D. Cline, B. Roman, and **G. J. Doucette**. Remote detection of HAB species using the environmental sample processor (ESP): progress and future directions. Xth International Conference on Harmful Algae, 2002. St. Petersburg, FL

Workshops:

Doucette, G.J. (co-organizer) Workshop on Cyanotoxin Detection, Quantitation, and Instrumentation, 2001. St. Petersburg, FL,

Mikulski, C.M. Workshop on Use of Molecular Probe Technology for Detection of Harmful Algae, Mar. 2001, Monterey, CA.